

Two New Species of *Vexillum* from the Western Pacific (Gastropoda, Costellariidae)

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ABSTRACT

Vexillum brunneolinea n. sp. is described from the Palau Islands and compared to *Vexillum acuminatum* (Gmelin, 1791) and *V. semisculptum* (Adams & Reeve, 1850). It is the first member of its genus reported in which some individuals lack apertural lirations. *Vexillum elliscrossi* n. sp. is described from Hawaii and central Pacific guyots and compared to *Vexillum daedalum* (Reeve, 1845) and *Vexillum xenium* Pilsbry, 1921.

Key words: Costellariidae; Hawaiian Islands; Palau Islands; *Vexillum*.

INTRODUCTION

We first became aware of the two *Vexillum* species described in this paper more than twelve years ago. Our research in the literature at intervals during those years, involving study of the original descriptions of more than two thousand living and fossil species of miters (mitrids and costellariids), failed to uncover names for these taxa, although during that period both species were illustrated under erroneous names. We have not assigned the species we describe to subgenera because the limits of the subgenera of *Vexillum* are poorly defined and will surely change as anatomical knowledge of the group increases. On the basis of shell characters, it is possible that *Vexillum brunneolinea* n. sp. will be assigned to the subgenus *Costellaria*, and *V. elliscrossi* n. sp. to the subgenus *Pusia*.

SYSTEMATIC DESCRIPTIONS

Family Costellariidae MacDorald, 1860

Genus *Vexillum* Röding, 1798

Vexillum brunneolinea new species
(figures 1-3)

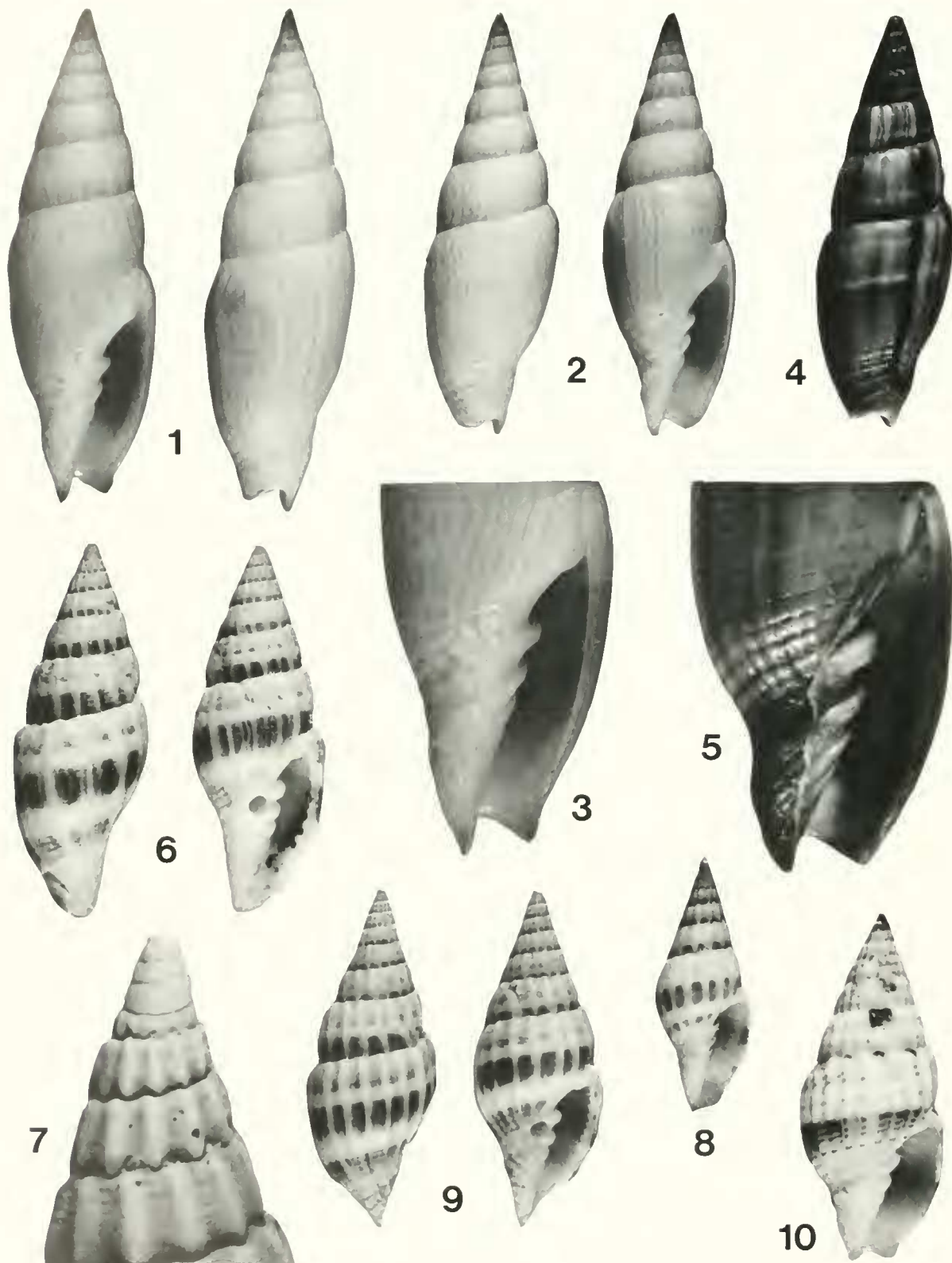
Vexillum (*Costellaria*) *acuminatum* f. *politum* "Reeve" Turner, 1989, pp. 12, 28, pl. 5, fig. 21, right hand specimen only; not *Mitra politum* Reeve, 1844.

Description: Adult shell length ranges from 17.4 to 25.5 mm; width ranges from 28 to 33 percent of length, and spire height from 37 to 42 percent of shell length. A summary of measurements is given in table 1. The shell

is white with 29 to 57 fine brown axial lines visible through a pale yellow periostracum. In live-collected specimens the periostracum is greenish-yellow and opaque. The green color may be due to the presence of commensal algae, as it rapidly fades after collecting.

The protoconch and first three or four teleoconch whorls are dark rust in color. The protoconch is smooth, about 0.5 mm in diameter and consists of about 2.2 whorls; the teleoconch consists of 8.9 to 10.5 convex whorls. The upper whorls have 12 to 20 axial ribs per whorl, typically 13 to 16. These ribs become obsolete by the penultimate whorl, which is smooth. On the upper three teleoconch whorls, there are 3 or 4 spiral grooves, which in some cases increase to five in number on succeeding whorls. These grooves are visible as pits between the axial ribs, but do not cross the ribs; they usually become obsolete by the penultimate whorl, but are still faintly visible on the body whorl in some specimens. There are three to seven spiral cords above the fasciolar ridge, and four to six below it on the siphonal fasciole. In some specimens the cords on the fasciole are obsolete or absent. The aperture and columella are white. There are four plications on the columella; the strongest is the posterior-most, which ranges up to 0.40 mm in width distally in adult specimens. There are 0-13 apertural lirations. In some specimens the lirations are of normal strength for *Vexillum*, in others they are shortened, reduced in number or in length, or, in seven specimens, are entirely absent. To make sure that lirations were lacking, a high intensity light was shone through the body whorl opposite the aperture. This procedure shows any trace of a liration in high relief, and none were detected in these specimens. The lack of apertural lirations has not been documented in any other *Vexillum* species.

The radula of the holotype is preserved on a slide prepared at the Academy of Natural Sciences (ANSP) between 1955 and 1958 by the late Virginia Orr Maes; it is typical of *Vexillum* species as illustrated by Cernohorsky (1970). The radula is fragmentary, with only 26 rows of teeth represented. Its width is 0.14 mm. The spacing between rows is about 0.025 mm, so there would have been about 40 rows of teeth per millimeter of ribbon length. The rachidian teeth have eight to ten cusps; the



Figures 1-3. *Vexillum brunneolinea* new species. 1. Holotype, length 25.5 mm, ANSP 217492, with periostracum. 2. Paratype, length 21 mm, Salisbury collection, periostracum removed. 3. Apertural detail of holotype, aperture length 11.5 mm. Figures 4, 5. *Vexillum acuminatum* (Gmelin, 1791). 4. Form *politum* (Reeve, 1844), length 20.5 mm, ANSP 28635, Philippines. 5. Apertural detail of large individual, aperture length 16.3 mm, ANSP 29699, Sri Lanka. Figures 6-9. *Vexillum elliscrossi* new species. 6. Holotype, length 18.5 mm, BPBM 219991. 7. Paratype, apex, coated with magnesium oxide, IMT Sta. 73-15. 8. Same specimen

lateral teeth are smooth. The rachidians are 0.08 mm in length, the laterals 0.06 mm; the ratio of their lengths is 1.33. Radular statistics are all within the ranges reported by Cernohorsky (1970:10) for *Vexillum*.

Type material: HOLOTYPE. ANSP 217492 (radula slide 937), 25.5 × 7.5 mm. PARATYPES. ANSP 202887 (1 specimen); ANSP 203082 (3 specimens); ANSP 203341 (2 specimens); ANSP 203787 (2 specimens); ANSP 217471 (2 specimens, bodies in ethanol); ANSP 382159 (1 specimen). Salisbury Collection, 7 specimens. Paratypes total eighteen specimens.

Type locality: Dredged in sand at 9 meters, inside the outer reef 12.9 km WNW of Koror Island, Palau Islands, Western Carolines. 7°24'N, 134°21'E. Collected by A. J. Ostheimer, 3rd; Station 441-6, 21 August 1955.

Distribution: All known specimens have been taken in the Palau Islands. Data for ten paratypes at ANSP that were dredged by A. J. Ostheimer, 3rd in 1955 are as follows:

ANSP 202887—Sta. 452, at 31 meters, 3.2 km NE of Gamudoko Island off Urukthapel Island, 24 August. 7°17.5'N, 134°21.5'E.

ANSP 203082—Sta. 436, in sand at 27 meters, Malakal Harbor, 20 August. 7°19'N, 134°27'E.

ANSP 203341, 217471—Sta. 361, in clean fine sand at 8 to 12 meters, in bay on inner edge of barrier reef 1.6 km south of West Passage, Babelthuap Island, 16 July. 7°31'N, 134°29'E.

ANSP 203787—Sta. 450, at 33 meters, east of Yoo Passage, 4.8 km NE of Eil Malk, 24 August. 7°12'N, 134°25.7'E.

The other paratypes were collected by Dieter Cosman using SCUBA in April 1978 in sand at 5.5 meters in the rock islands around Koror. One of these is ANSP 382159, the other seven are in the Salisbury collection. Turner (1989, pl. 5, fig. 21, right-hand specimen) published a color photograph of a 24 mm specimen in the Ted Baer collection taken at 10–20 meters in sand and fine rubble in Palau.

Etymology: "*Brunneolinea*" is derived from Latin *brunneus* (brown) and *linea* (line) referring to the brown axial lines characteristic of the species. It is a noun in apposition, and so does not change endings to match the gender of the genus.

Discussion: This species was considered a variant of the *politum* form of *Vexillum acuminatum* (Gmelin, 1791) by Turner (1989, p. 12). *Vexillum brunneolinea* is easily distinguished from typical *Vexillum acuminatum* as the latter is brown in color, has a light band below the suture and has axial ribs on the body and penultimate whorls. *Vexillum acuminatum* form *politum* (Reeve, 1844) (fig-

Table 1. Measurements (mm) and counts of conchological features of *Vexillum brunneolinea* n. sp. Number of specimens varies because in some cases values for juvenile, damaged and worn specimens were omitted or could not be determined.

	Mean	Range	N
Shell length	21.3	17.3–25.5	10
Body whorl length	13.0	10.1–15.6	10
Body whorl width	6.4	5.0–7.6	10
Spire length	8.3	7.1–9.9	10
Aperture length	9.5	7.3–11.5	10
Aperture width	2.3	1.7–2.8	10
Plica 1 width	0.32	0.20–0.40	10
Teleoconch whorls	9.6	8.9–10.5	10
Ribs, whorl 1	12.8	12–14	14
Ribs, whorl 2	13.6	12–16	19
Ribs, whorl 3	14.5	13–17	19
Ribs, whorl 4	14.9	13–18	19
Ribs, whorl 5	16.0	13–19	18
Ribs, whorl 6	15.9	13–20	17
Protoconch width	0.49	0.47–0.52	15
Protoconch whorls	2.2	2.1–2.4	6

ure 4) is smooth on these whorls, and sometimes develops a pattern of brown axial lines on a grayish-brown background. However, these lines are broader and more widely spaced than those in *V. brunneolinea*. The lines are darkly pigmented areas along growth lines of the shell, whereas the axial lines in *V. brunneolinea* are somewhat flexuous and in some cases bifurcate; they do not follow the growth lines.

Another feature that separates these species is that the posteriormost columellar tooth in fully mature individuals of *V. acuminatum* is broader than that in *V. brunneolinea*, and is often grooved at the top, giving it a biplicate appearance (figure 5). This tooth is convex in outline in *V. brunneolinea*. *Vexillum acuminatum* has been recorded from Palau, so *V. brunneolinea* cannot be considered a geographical variant of it.

Some forms of *Vexillum semisculptum* (Adams & Reeve, 1850) are also morphologically similar to *V. brunneolinea*. The species is usually ribbed, but as in *V. acuminatum*, smooth variants are known. However, the coloration of *V. semisculptum* is a uniform greenish, bluish or grayish brown with a white line below the suture. The aperture is brown except for the white line visible there also. Its color pattern differs strikingly from that seen in *V. brunneolinea*.

Vexillum elliscrossi new species
(figures 6–9)

Pusia daedala "Reeve," Kosuge, 1979, p. 27, pl. 6, fig. 28, not

Mitra daedala Reeve, 1845.

Pusia sp., Salisbury, 1981, p. 6, figs. 8A–B (in color).

as fig. 7, length 12.8 mm. 9. Paratype, length 17.2 mm, Salisbury collection. **Figure 10.** *Vexillum xenium* Pilsbry, 1921, holotype, length 17.8 mm, ANSP 116983. **Note:** All figures except 3, 5 and 7 are printed at the same magnification.

Table 2. Measurements (mm) and counts of conchological features of *Vexillum elliscrossi* n. sp. Number of specimens (N) varies because in some cases values for juvenile, damaged and worn specimens could not be determined.

	Mean	Range	N
Shell length	17.4	16.9-18.5	3
Body whorl length	10.7	9.8-12.0	4
Body whorl width	6.3	5.8-6.8	4
Spire length	6.3	6.2-6.4	3
Aperture length	8.6	7.7-9.5	4
Aperture width	2.5	2.5-2.7	4
Apertural lirations	9.3	6-13	6
Plica 1 width	0.38	0.30-0.46	4
Teleoconch whorls	7.5	7.0-7.8	3
Ribs, whorl 1	13.7	12-15	3
Ribs, whorl 2	14.6	12-16	5
Ribs, whorl 3	15.0	12-16	5
Ribs, whorl 4	16.2	12-19	5
Ribs, whorl 5	17.4	14-22	5
Ribs, whorl 6	18.4	16-23	5
Ribs, whorl 7	20.0	18-23	3
Protoconch width	0.62	0.60-0.64	3
Protoconch whorls	4.4	4.4-4.5	2

Description: Shell length of adult specimens ranges from 16.9 to 18.5 mm; body whorl width and spire height both range from 35 to 38 percent of shell length. A summary of measurements is given in table 2. The shell is white with four brown bands on the body whorl, two of which are visible on the spire whorls. The band below the suture is sometimes faint and is lightest near the suture; the band below it is the darkest of the four. Fresh specimens are suffused with lavender, which fades rapidly after collecting. The axial ribs are white and cut the brown bands into a series of tightly spaced blotches. The aperture and columella are white. All specimens studied have large, diagonal scars where breaks in the shell were repaired.

The protoconch is amber in color and appears smooth under a light microscope. It is tall (0.90-0.95 mm), consisting of about 4.4 whorls. There are up to eight teleoconch whorls. These are convex and slightly terraced. The number of ribs on the early teleoconch whorls ranges from 12 to 16, and increases to about 20 on the body whorl. Spiral grooves are visible between the ribs. These are faint on the first three teleoconch whorls and increase in strength towards the body whorl. From 7 to 9 grooves are visible on the spire whorls and 24 to 28 are visible on the body whorl. The grooves on the body whorl are stronger and more widely spaced along the siphonal canal. There is no siphonal notch and consequently there is no fasciolar ridge or distinct siphonal fasciole. There are four plications on the columella; the strongest is the posteriormost, which is up to 0.5 mm wide. There are 6 to 13 apertural lirations.

Type material: HOLOTYPE. BPBM 219991, 18.5 × 6.5 mm. PARATYPES. IMT, 3 uncatalogued specimens;

Salisbury Collection, 1 specimen; Leonard Hill Collection Cs-173, 1 specimen, figured by Salisbury (1981).

Type locality: Off Waikiki, Oahu, Hawaii, at 180 meters on a sand bottom, collected by the "Pele Expedition" on 21 March 1965.

Distribution: The three paratypes in IMT were cited by Kosuge (1979), from stations 73-3 (29°47.0'N; 179°04.7'E), 73-4 (29°47.4'N; 179°02.9'E), and 73-15 (26°18.9'N; 174°30.9'W) on central Pacific guyots west of Midway Island. We did not examine a fourth specimen, figured by Kosuge (pl. 6, fig. 28), from station 73-25 (29°48.0'N; 179°01.3'E) as it was not included in the material loaned to us. The IMT specimens were dredged in March 1973 at depths from 67 to 267 m. The paratype in the Salisbury collection was dredged off Keehi Lagoon, Oahu by E. R. Cross. The paratype in the Hill collection was taken off Honolulu at about 90 meters in rock and coralline algal rubble.

Etymology: We are pleased to name this species in honor of Ellis R. Cross, editor emeritus of the Hawaiian Shell News, who collected one of the paratypes. His work with deep-dredged shells has contributed greatly to knowledge of the molluscan fauna of the Hawaiian Islands.

Discussion: Kosuge (1979) identified *Vexillum elliscrossi* as *Vexillum daedalum* (Reeve, 1845), but it is easily distinguished from that species. *Vexillum daedalum* has a brown or ashy green shell with a single white peripheral band, whereas *V. elliscrossi* has a white shell with four brown bands. The aperture and columella are brown in *V. daedalum* and white in *V. elliscrossi*. The axial ribs on the body whorl in *V. daedalum* number 10 to 15 (Cernohorsky, 1972), whereas *V. elliscrossi* has 18 to 23 ribs. *V. daedalum* has a siphonal notch and fasciole whereas *V. elliscrossi* lacks the notch and fasciole. The shell that Kay (1979) illustrated from Hawaii as *Vexillum* sp. cf. *rufofilosum* (E. A. Smith, 1876) may be a deep water form of *Vexillum daedalum*. Cernohorsky (1972) and Turner (1989) considered *V. rufofilosum* to be synonymous with *V. daedalum*; Turner illustrated the holotype of *V. rufofilosum*. *Vexillum oniscinum* (Lamarck, 1811) might prove to be an older name for *V. daedalum*.

Another species that occurs in Hawaii that might be confused with *Vexillum elliscrossi* is *V. xenium* Pilsbry, 1921 (figure 10). The holotype of *V. elliscrossi* was originally catalogued at the Bishop Museum as "*V. (C.) xenium?*" but comparison to the holotype and paratype of *V. xenium* (ANSP 116983) shows that the species are easily distinguished. The apertural lirations in *V. xenium* are interrupted; in *V. elliscrossi* they are continuous. *Vexillum xenium* has a siphonal notch and fasciole; these are lacking in *V. elliscrossi*. The brown peripheral band in *V. xenium* is strongest on top of the spiral cords and lighter in the grooves. There are several narrow bands of brown on top of individual cords elsewhere on the whorl; these are darkest where they cross the ribs and lighter or absent in the interspaces. In contrast, the brown

bands in *V. ellisrossi* do not cross the ribs, but cover the spiral cords and grooves uniformly. *Vexillum xenium* also has scattered brown subsutural blotches; these blotches are absent in *V. ellisrossi*.

ACKNOWLEDGEMENTS

We thank Dieter Cosman for sharing his knowledge of *Vexillum brunneolinea* with us. We regret that we could not name the species for him, but there is already a *Vexillum cosmani* Kay, 1979, and the International Commission on Zoological Nomenclature discourages giving species in the same genus or in allied genera names honoring the same person [ICZN Recommendation D(I)6]. We thank Robert H. Cowie of the Bernice P. Bishop Museum (BPBM), Leonard C. Hill (Miami, Florida), and Sadao Kosuge of the Institute of Malacology, Tokyo (IMT) for providing information and loaning specimens.

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